What future teachers think about the disposition and the security to teach Mathematics? Some proposals for initial training

*Angel Alsina**

Abstract

In this study, the beliefs of 141 future teachers about the disposition and security to teach mathematics are analyzed. For the identification of these beliefs, two previously validated questionnaires have been administered and the data have been analyzed through a quantitative methodology. The results show that more than half of students believe that not all people have the same ability for mathematics; a significant percentage is more insecure to teach mathematics than other disciplines; and the students who present more positive beliefs come from a scientific baccalaureate. These results provide information to design teaching strategies during initial training that favor the professional development of future teachers.

Keywords : Teaching of mathematics, teacher training, initial training, pedagogical ability.

Introduction

Future teachers access to university studies having established different relationships with subjects, such as disinterest, apathy, anxiety and even fear of content and learning, or on the opposite side, interest, longing, tranquility or security, among others. These relationships are determined by factors such as self-concept, aptitude, the role played by the teacher, etc. (Beauchamp and Thomas, 2009).

In the specific case of mathematics, some preliminary studies have revealed the feeling of inferiority of students for teachers in this subject (Caballero, Blanco and Guerrero, 2008, Op't Eynde, De Corte and Verschaffel, 2002, Ministry of Education, Culture and Sport, 2012, López and Alsina, 2016). Gómez-Chacón (2000) indicates that it would be an error to attribute this vision only to an intellectual matter, since the affective domain also plays an important role.

McLeod (1992) distinguished three constructs within the affective domain: emotions, attitudes and beliefs. DeBellis and Goldin (1999) added the values as a fourth construct, and a few years later Hannula, Op't Eynde, Schlöglmann and Wedege (2007) proposed a model on the affective domain in mathematical education that, in addition to the previous constructs, considers also the sociocultural context and the classroom.

In relation to beliefs, which is the aspect in which we are interested in deepening, we assume the meaning of Gómez-Chacón, Op't Eynde and De Corte (2006), according to which a belief is never held independently of others, for This is usually talk about belief systems and not isolated beliefs.

This belief system, as indicated, is configured during pre-university training based on the relationships that students establish with mathematics. Di Martino and Zan (2010) establish three interconnected dimensions from a study with more than 1,600 students from Primary to Bachillerato: the emotional disposition towards mathematics (positive-negative); b) the vision of mathematics (relational-instrumental); and c) perceived mathematical competence (high-low). These authors conclude that teachers should learn to deal with these dimensions, so they emphasize the importance of incorporating them as part of didactic knowledge during teacher training. In this sense, they state that:

Reflection on the role of the teacher in student relationships with mathematics leads to the need to reflect with future teachers about their vision of mathematics and their own theories of success.(Di Martino and Zan, 2010, p.46).

Other research focused specifically on the beliefs of future teachers about mathematics and its teaching conclude that they are formed by an integrated system that includes beliefs about mathematics as a discipline, beliefs about oneself as a learner of mathematics and beliefs about mathematics. functioning of the class (Caballero et al., 2008; Ministry of Education, Culture and Sports, 2012; Op't Eynde et al., 2002). The main results of these preliminary studies agree that future teachers tend to perceive mathematics as a complex subject whose learning depends to a large extent on innate ability, together with the role played by the teacher. In this sense, the teaching methodology and evaluation are decisive.

The mentioned studies indicate that apprentices tend to perceive both the teaching and the evaluation of mathematics in a traditional way, mainly through activities based on repetition and the practice of exercises and the performance of exams. However, contemporary guidelines (National Council of Teachers of Mathematics [NCTM], 2015) point out that effective teaching is necessary that involves students in meaningful learning through individual and collaborative experiences that enhance their ability to make sense of ideas mathematics and to reason meaningfully.And regarding the evaluation, it is indicated that it should be an integral part of the teaching in order to offer evidence of the mastery of important mathematical content and relevant mathematical practices -including strategies and documentary sources. In addition, it should also serve to shape student feedback, teaching decisions and program improvement.

Kaasila, Hannula and Laine (2012) point out that studies about the vision of mathematics of future teachers have an important role because they reveal how they are building their beliefs about the teaching of this discipline. They suggest, in addition, that the awareness of these beliefs is the necessary starting point to promote processes of change and development in the teaching staff. But we must not forget, according to Gellert, Espinoza and Barbé (2013), that

during this awareness may arise resistance and subversion if the apprentice considers that the adjustment or change are impossible or undesirable.

In this context, the aim of our study is to analyze the beliefs of future teachers towards mathematics both from the perspective of their learning and their teaching, and more specifically the disposition towards the subject and the security to teach it, with the object of being able to understand negative feelings and promote processes of change during initial training through appropriate teaching strategies.

II. Method

All the students of the first degree of the Master's Degree of the University of Girona (Spain) participated in the research: 72 of Early Childhood Education and 69 of Primary Education. It is, therefore, an intentional sample formed by 141 future teachers. The study is carried out with first-year students in order to design and implement in subsequent courses strategies that allow improving the experiences and relationships with mathematics of future teachers. Table I shows the distribution of students according to the type of studies of origin.

Two questionnaires were used to obtain data, which were validated by expert judgment (López and Alsina, 2016). These two questionnaires, according to the literature reviewed, collect various beliefs about mathematics and its teaching (López and Alsina, 2013):

Questionnaire I: contains 14 closed polytomic questions that are assessed with a Likert-type scale (1 = strongly disagree, 2 = somewhat disagree, 3 = no agreement or disagreement, 4 = somewhat agree, 5 = strongly agree). The first four questions analyze beliefs about the disposition and ability to learn mathematics (see table II); The following five questions analyze beliefs about one's ability to learn mathematics (see Table III); and the last five questions collect data referring to beliefs about the functioning of the class (see table VI).

Questionnaire II: contains two open questions about the preferred subjects to teach and the degree of security to teach mathematics, respectively.

The two questionnaires were administered on the same day of the first semester to all participants during an ordinary class session. For the analysis of the data, three phases were followed: the first consisted in reading all the answers to the closed questions in Questionnaire I; in the second, a thorough analysis of the answers was made in the two open questions of Questionnaire II; and in the last one a quantitative analysis was carried out with the program SPSS 17. The descriptive analysis of the individual variables was made through frequency tables and measures of centralization and dispersion. For the study of the relationship between variables of the two questionnaires, contingency tables and contrasts of independence were used by the Chi-Square statistical, applying a value of 5% to evaluate the significance of the contrasts.

III. Results

3.1 Analysis of the belief system about mathematics and teaching

The data obtained in the 14 closed polytomic questions of Questionnaire I are exposed. As indicated, the first group of questions collects data about beliefs about the disposition and ability to learn mathematics.

As can be seen in Table II, the percentage of future teachers who say they like mathematics tends to be slightly higher than those they do not like (46.1% vs. 36.1%). The variable that makes the difference, as will be seen later, is the type of previous studies carried out.

On the other hand, 80.8% of participants consider that there are different abilities to solve math problems and 59.6% believe that there are people who are better at math than others. A first reading of these results suggests that the majority of future teachers consider that intellectual ability is a factor that plays an important role in the learning of mathematics, which has already been shown in previous literature. Our results, however, complement the previous data since 91.5% of the participants consider that being good at mathematics does not necessarily mean being smarter.

The second set of questions in Questionnaire I (see Table III) collects data about the beliefs of future teachers as mathematics learners. For this reason, the issues raised refer to the relationships that have been established with this discipline throughout their schooling and, more specifically, affect their ability to learn the discipline.

The data obtained are, in general terms, not very encouraging: almost 20% of the participants in the study he considers that they are not useful for mathematics, even though the average is 2.4 points. This is a worrying fact, especially if we take into account that in Spain the studies and the teaching profession of Infant and Primary are generalist, so when they enter the profession it is very possible that they have to teach mathematics.

Another worrisome aspect is that although more than half of the participants believe that their ability to solve mathematical tasks does not differ from that of their peers, the percentage of future teachers who say they like to solve problems is only 36.2%, and many of they confirm that they have doubts when they solve them (51.8%). This is another aspect that should be dealt with explicitly during the initial teacher training, especially if we take into account that solving problems is one of the central axes of learning and teaching mathematics.

The last group of questions in Questionnaire I focuses on the beliefs of future teachers about the functioning of the class (see table IV).

The percentage of responses to the question "I liked math classes" is similar between those who express that they did not like and those who do (42.6% and 39%, respectively), which confirms that the relationships that students have established with mathematics they have been of a different nature. One of the factors that may have had greater weight is the influence of their teachers, since 80.8% say that they have influenced the learning of

mathematics. Although the formulation of the questionnaire question has not allowed to specify if the influence has been positive or negative, the answers on the degree of understanding of the explanations of their professors suggest that there are more participants with a positive evaluation than negative (51.8 and 17.7%, respectively). In general terms, therefore, the results obtained confirm those of previous studies (Caballero et al., 2008, Ministry of Education and Culture, 2012) -which indicate that the teacher plays a notable role in the construction of the belief system linked to learning of mathematics and its teaching.

The analysis of other aspects related to the functioning of the mathematics class, such as exams or questions that the teacher formulates out loud, has shown a low degree of security and confidence: 33.4% say that they did worse in the Mathematics exams than in other subjects and almost half were afraid that the math teacher would ask them in class because they felt insecure.

3.2 Analysis of the level of confidence to practice as future teachers

In this section the results obtained in the Questionnaire II are presented, in the first place the quantitative data are shown and then some evidences that justify their choice are shown.

Table V shows that only 23% of future teachers have chosen mathematics in the first place as a preferred subject to teach, while those who choose it last represent 45% of the total. The rest has chosen other subjects.

The most repeated arguments among those who state that they would like to be professors of mathematics are that they like the subject, they feel safe teaching it, they consider themselves good in mathematics, they think it is a subject that allows to use a more participative and dynamic methodology, or because they believe that to teach mathematics they should like it. Also in some cases they have stated that they would like to teach mathematics because it is a useful subject.

On the other hand, the arguments that appear most among those who choose mathematics last are low aptitude, low interest or insecurity. Many of them state that they would not know how to explain mathematics, they do not see themselves capable, they do not master them, they do not understand them, they get bad, they do not have enough knowledge, they do not like them, it is a very theoretical subject, etc. The bad experiences lived as students or the methodology are other factors that condition the fact of choosing mathematics last. Finally, other arguments that are mentioned less frequently are the difficulty of the subject, boredom or the uselessness of the contents, making clear allusion to the mathematics they were taught during their school career. As has already been pointed out, this is a worrying aspect, since when they access a workplace it is very possible that they have to teach mathematics, so it is essential that during the initial formation this negative vision is transformed.

Finally, table VI presents the data referring to the subject with which future teachers feel safer to teach.

Less than half of the 141 participants have referred to mathematics (n = 67). The most repeated arguments by the participants with a feeling of security towards mathematics (18%) are the confidence that has given them to teach particular mathematics classes, interest in the subject or because they believe that the level of mathematics content of Infant and Primary Education is low, but if they had to teach mathematics in Compulsory Secondary Education (ESO) or Baccalaureate they would not feel so safe anymore.

Fitness is one of the arguments that appears most frequently among students who mention mathematics as a subject with which they feel less secure (more than half have referred to this variable).Some participants have also mentioned the low interest in the subject, the experience as students or the difficulty of mathematics.

In order to understand more precisely how the relationships that students have established with mathematics during their pre-university studies have been analyzed, through the Anova test, whether the studies of origin exert any influence on the disposition towards mathematics.

Table VII shows that the highest average corresponds to the participants who come from a scientific baccalaureate. In contrast, future teachers who come from the humanistic baccalaureate - and especially those who come from FP / CFGS - are those that obtain a lower average. In order to compare the means, a multiple comparison test was carried out using the Tukey method: among the students coming from the scientific baccalaureate and those from CFGS a p -value of 0.009 (<0.05), so the difference between both groups is statistically significant.

Table VII. Means on the taste towards mathematics according to the access to the university

It was also considered opportune to analyze the relationship between the taste towards mathematics and the willingness and security to teach them. The results obtained by the Chi-Square tests are shown in tables VIII to XI.

Table VIII. Contingency table between the variables "I like mathematics" and "the preferred subject to teach"

A value of 0.000 <0.05 has been obtained, therefore we can reject the null hypothesis that the two variables are independent, confirming that there is a dependence between the disposition towards mathematics and the choice of mathematics as a preferred subject.

Table X. Contingency table between the variables "I like mathematics" and the "degree of security in relation to the teaching of mathematics"

In this case, given that the p- value is 0.000, it can be said that there is a relationship between both variables.

IV. Discussion and Conclusions

In this study we have analyzed the beliefs of the future teachers about mathematics and its teaching in general, and the disposition and aptitude to teach them in particular. The data obtained about the willingness of future teachers towards mathematics show an important dispersion between those who indicate that they like mathematics and those who do not, confirming in this way that they have established different relationships with this subject throughout their schooling. , in the line already indicated by Beauchamp and Thomas (2009). They also think that performance in mathematics depends on a natural ability. These results were already mentioned in the studies by Caballero et al. (2008) and the Ministry of Education, Culture and Sports (2012), among others.However, a distinctive element of this research is that future teachers do not consider that the best students are the smartest.

Regarding the beliefs of future teachers about their own aptitude to learn mathematics, the data obtained confirm a feeling of inferiority in this matter (Caballero et al., 2008, Ministry of Education, Culture and Sports, 2012, López and Alsina, 2016 ; Op 't Eynde et al., 2002). A novel fact that our study contributes is that this vision differs in a statistically significant way according to the studies of origin: the participants that come from a humanistic formation or from a CFGS they stress exam difficulties, job insecurity or, more generally, less confidence in their math skills than those from a science baccalaureate.

Beliefs about the functioning of the mathematics class confirm that the teacher plays an important role in the vision of learning mathematics and its teaching (Caballero et al., 2008), and have revealed, in addition, a low degree of security and confidence in front of the mathematical tasks.

In addition to the previous beliefs, we have also investigated the level of confidence and the feeling of security that future teachers present to teach mathematics. The results are worrisome, since 45% of the participants indicated that the subject they least like to teach is mathematics.

In conclusion, then, the main negative feelings that were identified in the study are the scarce disposition and aptitude towards mathematics and its teaching. As indicated, a significant group of participants stated that they would not know how to explain mathematics.

We believe that, instead of the trainers remaining anchored in the idea that there are students for teachers with a negative view, during the initial training they should develop adjustments to this situation taking into account the indisputable social value of mathematics. In this sense, we agree with Contreras, Penalva and Torregrosa (2011), in which the starting point to make these adjustments is to encourage the reflection of future teachers about their own formative experience in relation to mathematics, and also about their own expectations about success so that they learn to deal with perceived competition (Di Martino and Zan, 2010).

Thus, for example, in order to avoid stigmatizing students based on their ability, an inclusive vision of mathematics should be encouraged using didactic strategies, such as the presentation of case studies or the use of video episodes and the role playing to be configuring a teaching profile that contributes to the principle of equality in mathematics education, that is,

that mathematics can and must be learned by all (NCTM , 2000). Also, so that they do not reproduce inadequate teacher models, an essential task during the initial training should be to favor the awareness of these teacher models and offer alternatives for action, along the lines indicated by Kaasila et al. (2012).

More generally, and considering the negative feelings identified, it would be necessary to use teaching methodologies based on systematic reflection to deconstruct these feelings and, at the same time, co-construct new scientific and professional knowledge. Some of the didactic strategies that trainers should apply and the aspects that should be dealt with in the framework of these reflexive methodologies are the following (Alsina, Batllori, Falgàs and Vidal, 2019):

Previous experiences: past situations that have left a negative imprint in the construction of mathematical identity or in the construction of professional identity to teach mathematics.

Beliefs about oneself: the internal look as an apprentice or as a future teacher of mathematics.

Beliefs about the functioning of the class: conceptions about the methodological lines of schools, how to manage teaching practices and even the different types of relationships between professionals.

Implicit disciplinary knowledge : the vision about mathematics and the knowledge that integrates them.

Implicit didactic knowledge: the vision about the way to teach mathematics.

Interaction with the context I (School center): the contrast with the context of the infantile or primary classroom based on participant observation and situated learning, mainly.

Interaction with context II (University): the contrast with the pedagogical context (in this case, in the university) also from active participation and situated learning.

Interaction with oneself: the internal dialogue through introspection.

Interaction between equals: communication with others, through cooperative work, negotiation and reflective dialogue.

Interaction with the expert: communication with the most expert, also through reflective dialogue and negotiation.

Interaction with theory: the contrast with both disciplinary and didactic knowledge linked to the construction of the teaching profile to teach mathematics.

During the application of these aspects it is possible, as Gellert et al. (2013), that resistances and subversions arise if apprentices for teacher consider that the change is impossible or unwanted.For this reason, an initial training of mathematics teachers that leads to change should provide disciplinary and didactic knowledge that can transform the negative feelings

detected through reflective methodologies, in order to solve the problem posed. In future studies it will be necessary to apply the aforementioned teaching strategies to analyze their impact on the process of self-regulated construction of the teacher profile of future teachers, which includes both professional knowledge and critical thinking.

References

1. Alsina, Á., Batllori, R., Falgàs, M., and Vidal, I. (2019). Self-regulation marks for the construction of the teaching profile during teacher training. Complutense Magazine of Education, 30 (1), 55-74.
2. Beauchamp, C. and Thomas, L. (2009). Understanding teacher identity: an overview of issues in the literature and implications for teacher education. Cambridge Journal of Education, 39 (2), 175-189.
3. Caballero, A., Blanco, LJ, and Guerrero, E. (2008). The affective domain in future teachers of mathematics at the University of Extremadura. Paradigm, XXIX (2), 157-171.
4. Contreras, P., Penalva, MC, and Torregrosa, G. (2011). Professional identity and mathematical knowledge for the teaching of teachers in training. In M. Marín, G. Fernández, LJ Blanco and M. Palarea (Eds.), Research in Mathematical Education XV (pp. 329-338). Real city: SEIEM .
5. DeBellis, V. A. and Goldin, G. A. (1999). Aspects of affect: Mathematical intimacy, mathematical integrity. In O. Zaslovsky (Ed.), Proceedings of the 23th International Conference Group for the Psychology of Mathematics Education (Vol. 2, pp. 249-256). Haifa, Israel: PME.
6. Di Martino, P. and Zan, R. (2010). "Me and maths": towards a definition of attitude grounded on students' narratives. Journal of Mathematics Teacher Education, 13 (1), pp. 27-48.
7. Gellert, U., Espinoza, L., and Barbé, J. (2013). Being a mathematics teacher in times of reform. ZDM -The International Journal on Mathematics Education, 45 (4), 535-545.
8. Gómez-Chacón, IM (2000). Emotional Mathematics Affects in mathematical learning. Madrid: Narcea.
9. Gómez-Chacón, IM, Op't Eynde, P., and De Corte, E. (2006). Beliefs of the students of mathematics. The influence of class context. Teaching of Sciences, 24 (3), 309-324.
10. Hannula, MS, Op't Eynde, P., Schlöglmann, W., and Wedege, T. (2007). Affect and mathematical thinking. In D. Pitta-Pantazi and G. Philippou (Eds.), European Research in Mathematics Education V; Proocedings of the Fifth Congress of the European Society for Research in Mathematics Education (pp.2020-208). Nicosia: University of Cyprus.
11. Kaasila, R., Hannula, MS, and Laine, A. (2012). "My personal relationship towards mathematics has not changed but ..." Analyzing pre-service teachers' mathematical identity talk. International Journal of Science and Mathematics Education, 10 , 975-995.
12. López, P. and Alsina, A. (2013). How do beliefs about oneself influence in

relation to mathematics? An approach to the role of mathematical identity in future teachers. In A. Berciano, G. Gutiérrez, A. Estepa and N. Climent (Eds.), Mathematical Education Research XVII (pp. 345-353). Bilbao: SEIEM.

13. López, P. and Alsina, A. (2016). Beliefs of the future teachers on the mathematical aptitude: considerations to promote processes of change in the initial formation. Bolema, 30 (56), 892-905.
14. McLeod, DB (1992). Research on affect in mathematics education: a reconceptualization. In DA Grouws (Ed.), Handbook of research on mathematics learning and teaching (pp. 575-596). New York: McMillan.
15. Ministry of Education, Culture and Sports (2012). TEDS-M . Spanish report. International study on initial teacher training in mathematics . Madrid: General Subdirectorate for Documentation and Publications.
16. National Council of Teachers of Mathematics. (2000). Principles and standards for school mathematics . Reston, VA : NCTM.
17. National Council of Teachers of Mathematics. (2015). From principles to action: to guarantee the mathematical success of all. Reston, VA : NCTM.
18. Op't Eynde, P., De Corte, E. and Verschaffel, L. (2002). "Framing students' mathematics-related beliefs: a quest for conceptual clarity and a comprehensive categorization". In G. Leder, E. Pehkonen and G. Torner (Eds.), Beliefs: a hidden variable in mathematics education? (pp. 13-37). Dordrecht, The Netherlands: Kluwer Academic Publishers.